Original Contribution

Pilot Study of Meaningful Use of Electronic Health Records in Radiation Oncology

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Abstract

Purpose: Adoption and meaningful use of electronic health record (EHR) systems is an important national goal. We undertook a pilot study to determine the level of adoption and barriers to implementation of meaningful use (MU) of EHR systems as defined by the Centers for Medicare & Medicaid Services (CMS) in US radiation oncology practices.

Materials and Methods: We administered a Web-based survey instrument to a convenience sample of 40 departments of radiation oncology. We determined the current status of EHR system use at each facility, attitudes toward EHR systems, knowledge of MU criteria, plans and barriers to implementation, and whether selected interventions would be helpful with regard to compliance with MU criteria.

Results: Twenty-one of 40 radiation oncology facilities completed the survey, for a 53% response rate. Respondents were mostly large academic practices with a median of six (range, one to 32) full-time physicians and 70 (range, eight to 650) patients treated daily. Most facilities (81%) currently used an EHR system. The majority (84%) of facilities were aware of MU criteria, and of these, 67% expected to implement MU-compliant systems by the year 1 reporting deadline of October 1, 2011. The most frequently cited barriers to implementation were high cost, difficulty integrating with hospital systems, and a lack of national guidelines for implementation.

Conclusion: Most large academic radiation oncology practices have already incorporated EHR systems into practice and plan to meet MU requirements. Further work should focus on assessment of needs for smaller practices. Radiation oncology–specific guidelines may improve widespread adoption.

Introduction

The influential 1999 Institute of Medicine report, *To Err Is Human*, found that up to 96,000 lives were lost each year as a result of medical error.[1] In the wake of increased interest in safety and quality of medical care, the Institute of Medicine and others identified information technology (IT) as a crucial tool to improve safety and reduce medical errors.[1-4] As a core component of health IT, the broad adoption of electronic health record (EHR) systems has become a national priority.[1,3-6] EHR systems facilitate data collection and have been shown in multiple settings to improve clinical outcomes.[7-10]

To achieve full potential, EHR systems must be used in a meaningful manner rather than treated simply as an electronic form of paper charts. The HITECH (Health Information Technology for Economic and Clinical Health) Act of 2009 authorized the Centers for Medicare & Medicaid Services (CMS) to offer financial incentives for constructive integration of EHR systems into clinical practice according to defined specific meaningful use (MU) criteria.[5,6] The initial phase (stage I) of MU criteria emphasizes establishment of functionality that will promote continuous quality improvement and streamline transfer of information. To qualify for Medicare incentives starting in 2011, eligible professionals were required to have implemented mandatory reporting by October 1, 2011.[5,6]

It is unclear to what extent US radiation oncology practices are currently ready to fulfill the CMS MU criteria. US physicians are noted to have variable levels of EHR system use,[11,12] and a 2008 report of US ambulatory care physicians reported that only 4% had fully functional EHR systems.[13] Recent reviews found user attitudes, workflow impact, ease of integration into existing systems, technical support, communication among users, and expert support to be important determinant factors for adoption of EHR systems.[14-16] As a specialty, radiation oncology has better integration with electronic information systems,[17] but no data exist on the degree of EHR systems integration into practice. Identification of specific barriers to implementation of EHR systems that fulfill MU criteria can help guide national efforts toward the goals of full national compliance and of improvement in quality and safety in radiation oncology.

Adoption of new technologies such as meaningful use of EHR systems may be evaluated in the commonly accepted diffusion of innovation (DOI) model. In the DOI model, new technological innovations gain acceptance according to a sigmoidal shaped curve over time, with few initial adopters and rapidly increasing rate of adoption after a critical mass is reached. Within the adoption process, each user makes a decision to accept or reject the innovation on the basis ofo his or her individual cost-benefit analysis. This process typically proceeds through five sequential steps: knowledge, persuasion, decision, implementation, and confirmation.[18] We hypothesize that for radiation oncology practices, the rate-limiting steps in the adoption of MU criteria for use of EHR systems are deficiencies in knowledge and in resources

for implementation. We developed a survey of national radiation oncology practices to test this hypothesis and to evaluate potential ways to improve implementation.

Materials and Methods

Survey Content and Development

We developed our survey on the basis of a review of published surveys of EHR use[13] and incorporated the combined input of clinicians, information technology personnel, and health policy researchers. Revisions were tested by a focus group at the Department of Radiation Oncology at Thomas Jefferson University (Philadelphia, PA). The survey instrument consisted of a 23-item questionnaire divided into four major sections: demographics (six questions), current status of EHR system use (seven questions), attitudes toward EHR systems (three questions), and status of MU compliance (six questions). We distinguished between electronic "record and verify" (R&V) systems used to track radiation delivery measurements for each daily treatment and EHR systems used for patients clinical record management. Respondents were asked to describe the current status of EHR system use at their facility, attitudes toward EHR systems, knowledge of MU criteria, plans and barriers to implementation, and whether selected interventions would be helpful with regard to compliance with MU criteria. The final survey instrument was approved by the institutional review board at Thomas Jefferson University. Questions and response choices are available in the Data Supplement.

Survey Sample and Administration

The survey was administered online using the SurveyMonkey Web site (www.surveymonkey.com). We selected a convenience sample of US radiation facilities; most were located in Pennsylvania. We initially classified academic and private practice by the presence or absence of resident physician training programs, and invitations were sent electronically to 22 private (no residents) and 19 academic (with residents) facilities. For analysis, we reclassified academic and private practice on the basis of self-identification. The chairperson at each facility was electronically mailed an invitation, which they could choose to complete or to forward to another clinician, information technology personnel, or other staff member who was most familiar with the facility's EHR system. Only one response was collected from each facility. Nonresponding facilities were sent electronic reminders. The survey was initiated on March 30, 2011, and data collection was completed on April 21, 2011.

Statistical Analyses

We performed descriptive statistics based on the survey responses. Differences in use between groups were tested using the Mann Whitney U-test or Fisher's exact test, with a two-sided α of 0.05. Analyses were performed using SAS (version 9.2; SAS Institute, Cary, NC).

Results

Respondent and Practice Characteristics

The electronic survey was sent to 40 radiation oncology facilities and completed by 21 (53% response rate). The majority of respondents self-identified as academic facilities, with a median practice size of six full-time radiation oncologists and a median daily volume of 70 patients receiving treatment (Table 1). Only four of 21 facilities self-identified as private practices. Half of respondents were department chairmen, and an additional 33% were clinicians or clinical directors. The average duration of experience in radiation oncology was 19 years. Geographic locations of practices were primarily in Pennsylvania (n = 12) but also included Maryland, California, Illinois, Massachusetts, New Jersey, Ohio, and Wisconsin.

EHR System Use Among Practices

All respondent facilities currently used an electronic R&V system, and a large percentage (81%) of the surveyed practices currently used at least one EHR system (Table 2). For the four facilities that reported no use of an EHR system, three self-identified as hospital-based academic practices and one as "other." Two of these four reported to be transitioning to or in the process of implementing EHR systems. Approximately one third (35%) of the 17 facilities with EHR systems reported using more than one system. The most commonly used EHR systems were Mosaiq (38%), Epic (24%), Aria (19%), and Allscripts (10%). Most facilities (71%) reported that they were at least content with their current EHR system, whereas the remaining (29%) were dissatisfied. There was no relationship between length of EHR system use and satisfaction ($P = .3$). For the surveyed personnel, the majority did not communicate with other facilities regarding EHR system–related issues, or did so only a few times per year (33% and 48%, respectively).

We investigated barriers to implementation of any EHR system apart from consideration of MU criteria. Among the 17 institutions with EHR systems, the most common challenge to successful EHR system implementation was unexpected difficulties in implementation (71%), followed by inadequate support services (52%) and high cost (47%). Only 18% of respondents felt that a lack of physician support was a barrier to EHR system adoption. Among the four institutions without EHR systems, all cited institutional barriers, and three cited high cost as an additional barrier.

Perception of Quality and Safety

Among the 17 facilities that use EHR systems, 71% reported that they believe EHR systems did improve safety or quality, whereas the remaining facilities were unsure (Figure A1, online only). No facility reported that they felt EHR systems did not improve quality or safety. Most facilities believed that EHR systems improved safety and quality in multiple areas (median three, range one to six). The most commonly cited areas were improved documentation, reduced treatment errors, and reduced medication errors (Figure A1).

Table 1. Respondent Characteristics*

Characteristic	No.	%
Facility type		
Hospital based academic	16	73
Free-standing academic	1	5
Hospital based private	3	14
Free-standing private	1	5
Other	1	5
Geographic location		
Pennsylvania	12	57
Maryland	2	5
California	1	2
Illinois	1	2
Massachusetts	1	2
New Jersey	1	2
Ohio	1	2
Wisconsin	1	2
Respondent role in department		
Chairman	11	61
Clinical director	3	14
Clinician	4	19
IT director/personnel	0	0
Other	3	14
Practice size†		
Median	6	
Range	1-32	
Radiation oncology experience, years		
Median	19	
Range	2-30	
Revenue from Medicare, %		
Median	35	
Range	20-60	
Daily practice volume, No. patients receiving treatment		
Median	70	
Range	8-650	

Abbreviation: IT, information technology.
* Percentages do not add to 100% due to rounding.
† No. of full-time equivalent radiation oncologists.

Table 2. Current EHR Use

Parameter	No.	%
Current record and verify system		
Elekta (Mosaiq/Impac)	10	48
Varian (Aria)	9	43
Siemens (Lantis)	2	10
Current use of EHR		
Yes	17	81
No	4	19
EHR systems used*		
Mosaiq/Impac	8	47
Epic	5	29
Aria	4	24
Allscripts	2	12
Cerner	1	6
Satisfaction with EHR		
Very satisfied	1	6
Satisfied	8	47
Content	3	18
Dissatisfied	5	29
Very dissatisfied	0	0
No EHR	4	N/A
Length of EHR use, years		
Median	5	
Range	0-18	

Abbreviations: EHR, electronic health record; N/A, not applicable.
* Does not add to 100% because some facilities used more than one EHR system.

MU in Radiation Oncology

Only three of 21 total respondents did not know about the MU program (all were institutions with existing EHR systems). A majority (62%) of respondents reported that they were at least "somewhat familiar" with MU criteria. All facilities reported the intention to eventually implement MU-compliant EHR system, with a majority already compliant (7%) or expected to be compliant by October 1, 2011 (60%). Plans for early implementation of MU criteria (by October 1, 2011) did not correlate with length of experience with existing EHR systems ($P = .84$) or perception of the ability of EHR systems to improve quality or safety ($P = 1.0$). Increased knowledge of MU criteria was associated with plans for early implementation ($P = .04$). Among respondents who had any knowledge of the MU criteria, the most common reasons for implementation were to collect CMS bonuses (83%) and to avoid penalties (78%), followed by desire to improve patient care (50%; Figure A2, online only).

Among respondents who had any knowledge of MU criteria, the most important barriers to implementation were cost, difficulty integrating with hospital systems, and lack of guidelines specific to radiation oncology standards (Figure 1). Most respondents (89%) felt that additional information on criteria specific to radiation oncology would be "moderately helpful" or "very helpful" in improving their implementation of MU compliant systems (Figure A3, online only). In addition, a majority (67%) believed that ASTRO-specific guidelines for implementation or ASTRO educational session (61%) would be "moderately helpful" or "very helpful."

Discussion

We present results of a pilot study of EHR system use and preparedness to demonstrate adoption of MU criteria in radiation oncology. Radiation oncology has a strong emphasis on safety, with ongoing projects initiated by the American Society for Radiation Oncology including Target Safely[19] (a comprehensive plan to improve safety) and Integrating the Health Enterprise–Radiation Oncology[20] (an initiative to improve equipment and software integration). We found that large academic radiation oncology practices have broad acceptance and

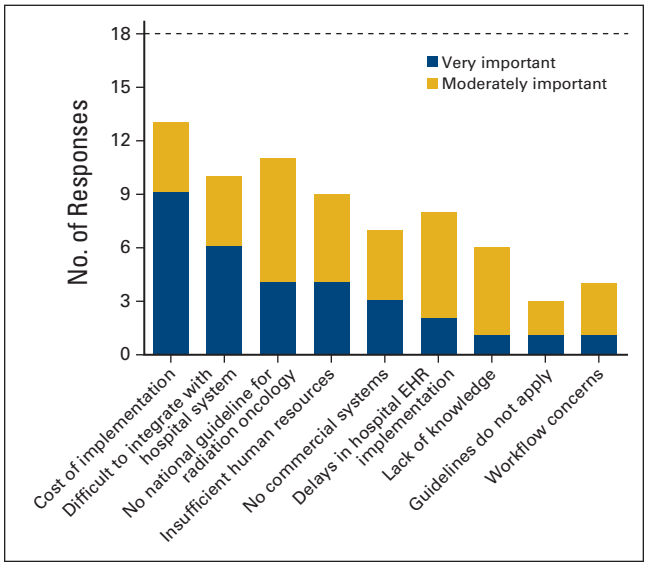

Figure 1. Most important barriers to implementation of meaningful use–compliant electronic health record (EHR) systems. Responses are based on 18 respondents with knowledge of meaningful use criteria.

staff support for the use of EHR systems to improve quality and safety, and that these practices intended to implement MU-compliant EHR systems within 2 years, if not by the year 1 reporting deadline of October 1, 2011. These findings suggest that large academic radiation oncology practices are poised to be leaders in IT solutions to safety and quality, but further work is needed to study the adoption of these solutions by smaller practices.

We analyzed the adoption of MU of EHR systems within a DOI framework, a widely accepted model to explain the adoption of new technologies in developed countries.[21] Applying the DOI model to the adoption of MU criteria, most facilities are currently in the implementation phase of adoption, with a few in the knowledge phase. Most were aware of MU guidelines, and many had plans to complete implementation of MU-compliant systems by the year 1 reporting deadline. No facility had enough experience incorporating the new MU guidelines into clinical practice to reach the confirmation stage. With the high rate of adoption among the surveyed facilities, MU has easily crossed the critical mass threshold among the radiation oncology academic community.

Despite an attempt to include nonacademic facilities, we did not accrue many private practice or small-sized facilities to our study. With a median practice size of six full-time radiation oncologists and daily treatment volume of 70 patients, our results should not be generalized to smaller facilities. Although a reason for the lower rate of responses from smaller facilities cannot be determined, it is possible that the low response rate was due in part to a lack of familiarity with MU criteria among these practices. Future studies will need to assess and address the needs of smaller practices.

Unlike many other medical and surgical specialties, radiation oncology already integrates electronic systems to accomplish such goals as R&V and dose checking in daily treatment delivery. The most popular R&V systems, Mosaiq (Elekta; Stockholm, Sweden) and Aria (Varian; Palo Alto, CA), have been designed to include EHR system capabilities. It is not surprising, therefore, to find high adoption of EHR system use among radiation oncology facilities. In our survey, most respondents (71%) appeared to advocate the effectiveness of EHR systems for quality improvement.

Cost remains a primary concern for radiation oncology facilities. Because commercial EHR systems need to be certified to meet MU requirements,[6] most facilities that purchased systems before the past year will need to upgrade. As of June 2011, for the users of Aria and Mosaiq, only the newest versions (Aria Version 10 MR2 and Mosaiq version 2.3) were fully MU compliant. The cost effectiveness of upgrading EHR systems to match MU guidelines has not been well investigated and likely will vary greatly by facility.

Additional ways to improve implementation of MU criteria in radiation oncology include development of specific guidelines adapted to specialty practice. The initial guidelines specify 15 common core objectives (such as computerized physician order entry, medication-medication and medication-allergy interaction checks, e-prescriptions) and an additional menu from which providers need to choose five (such as drug formulary checks, automated patient reminders, ability to generate searchable patient lists). Although pertinent to almost all practices, these criteria were designed to improve meaningful IT use in primary care. Shaping future criteria to match the potential for EHR systems in specialty practices will improve the effectiveness of MU. Multiple other specialities such as ophthalmology, radiology, and otolaryngology have published guidelines to help improve specialty-specific implementation of MU criteria.[22-26] Development of guidelines and quality measures that specifically target safety and quality in radiation oncology practices (such as documentation of prior radiation treatment, uniform documentation of quality assurance checks, and ability to share planning and treatment delivery information electronically) would improve outcomes in radiation oncology to a greater extent than the current general objectives. As we found that many facilities do not routinely communicate on IT issues, encouraging greater collaboration between facilities may also increase the ease of MU adoption. MU criteria offer an opportunity to develop guidelines to globally improve safety and quality in radiation oncology practices. More studies are required to define quality in radiation oncology and how EHR systems can potentially improve measures of quality and safety.

Our pilot study of EHR systems in radiation oncology found that most large academic practices had already incorporated EHR systems into practice and planned to meet stage 1 MU requirements. The ability of smaller radiation oncology practices to meet meaningful use criteria remains unclear. Future studies will focus on measures to improve implementation and determine potential unmet needs among smaller practices.

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Authors' Disclosures of Potential Conflicts of Interest

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Appendix

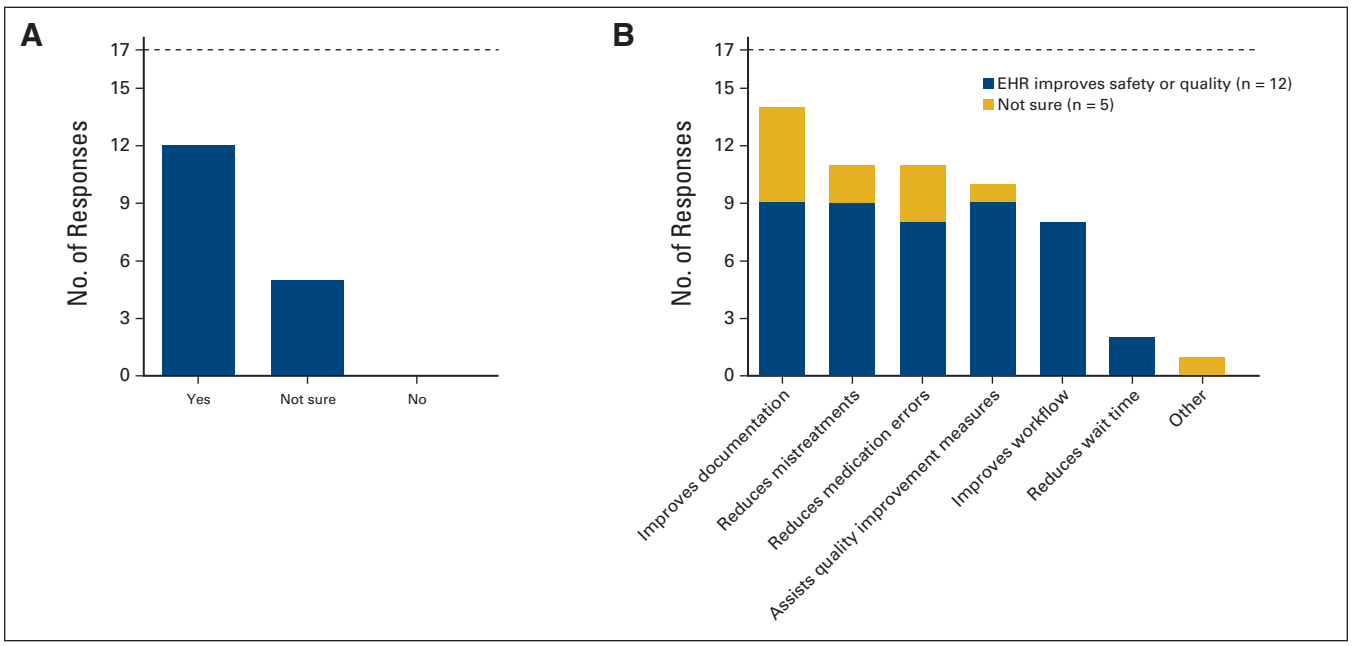

Figure A1. Perception of effect of electronic health record (EHR) systems on quality and safety. (A) No. of respondents to the question of whether EHR improved safety or quality of 17 facilities with EHR systems. (B) Ways in which EHR improved safety or quality among 17 facilities with EHR. Responses include both facilities which felt that EHR improved quality (n = 12) and safety and those that were not sure (n = 5).

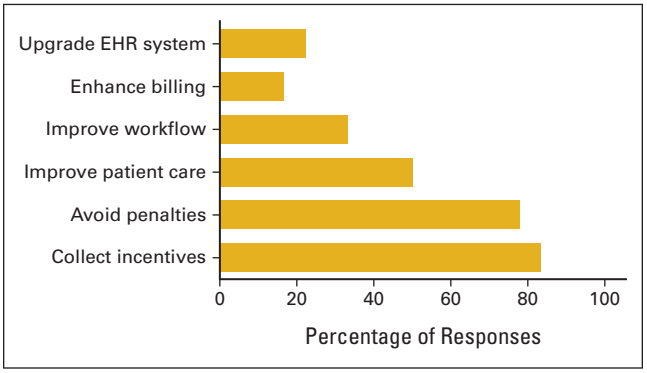

Figure A2. Reasons for implementing meaningful use–compliant electronic health record (EHR) systems. Responses are based on 18 respondents with knowledge of meaningful use criteria. Respondents were allowed to select multiple reasons.

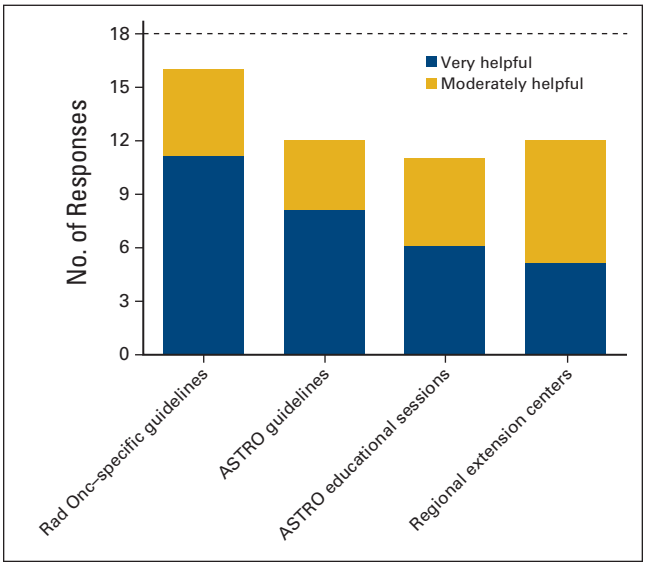

Figure A3. Most useful measures to help implementation of meaningful use–compliant electronic health record systems. Responses are based on 18 respondents with knowledge of meaningful use criteria. Rad Onc, radiation oncology; ASTRO, American Society for Radiation Oncology.